

PART 580 - DIVERSION - 362

SUBPART A - GRADIENT

§KS580.00 General

Design using the guidelines listed in Chapter 9 of the Engineering Field Manual and the criteria in the Kansas Standard and Specifications for Diversion - 362.

§KS580.01 Layout

(a) Use Form KS-ENG-8 for graded diversions and record the following items. Each letter represents the corresponding circled designation on the sample Form KS-ENG-8 on page KS580-6.

- (A) Owner/Operator
- (B) Legal description
- (C) County
- (D) Farm number (optional)
- (E) Tract number
- (F) Applicable identification number - GPCP, ACP, etc.
- (G) Check the appropriate line as to the known existence of any buried utilities. If buried utilities are known to exist, safety procedures listed in National Engineering Manual, Part 503, should be strictly followed.

Show the following on the location map:

- (H) Diversion location
- (I) Location of any known buried utilities
- (J) Map scale

Under the layout block on the front of the field sheet, record the following survey information:

- (K) Diversion, number, and reach
- (L) Stations
- (M) Rod readings for each diversion

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Record the following items in the appropriate locations:

(N) Determine the land slope in percent above each reach of the diversion. Record this slope under Line 19 of Design.

(O) Signature of person doing the layout and date.

(b) The information in this section may also be recorded on looseleaf field notebook sheets (Forms SCS-ENG-28 and SCS-ENG-29) or field note sheets (Forms KS-ENG-37 and KS-ENG-37a) and attached to the field sheet.

§KS580.02 Design

(a) Proper peak discharge determinations must be made prior to designing the diversion. Tables in Chapter 2 of the Engineering Field Manual and Form KS-ENG-137 are two acceptable methods for determining peak discharge. Form KS-ENG-137 should be filled out in accordance with the procedures contained in the Engineering Field Manual, Chapter 2.

(b) Using the same Form KS-ENG-8 that was used in Layout, record the following items. Each number represents the corresponding circled designation on the sample Form KS-ENG-8 on page KS580-6.

In the design block, determine and list the following:

- (1) Diversion, Number, and Reach
- (2) Station - (from and to)
- (3) Drainage area in acres
- (4) Weighted runoff curve number
- (5) Design Q, cfs
- (6) Channel design grade, %
- (7) Vegetal retardance or "n" value. The retardance value will be either A, B, C, D, or E for vegetated diversions. For farmed or annually vegetated diversions, an appropriate numerical "n" value must be used.
- (8) Design slopes: cut, front and back slope of the ridge.
- (9) Bottom width, ft.
- (10) Hydraulic flow depth, ft.

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- (11) Flow area, sq. ft. Leave blank for farmed or annually vegetated diversions that are designed using the Engineering Field Manual, Pages KS-9-24 and KS-9-25.
- (12) Velocity, fps. For farmed or annually vegetated diversions, record the velocity from the Engineering Field Manual, Pages KS-9-24 and KS-9-25. For vegetated diversions, calculate velocity by dividing Line 5, Design Q, by Line 11, Flow Area.
- (13) Top width of ridge, ft.
- (14) Design settled height, ft. (Line 10, Hydraulic Flow Depth + 0.5 ft. freeboard).
- (15) Minimum constructed height, ft. (Line 14, Design Settled Height x 1.10)

Under the Design Volume Computations on the front of Form KS-ENG-8, list the following:

- (16) Beginning station
- (17) Ending station
- (18) Length of diversion reach in feet
- (19) Land Slope, already completed by Line N of Layout.
- (20) Area of Excavation in sq. ft. (See Engineering Field Manual, Pages KS-9-1 through KS-9-23)
- (21) Volume of excavation in cu. yds. (Line 18, Length of Diversion x Line 20, Area of Excavation) /27
- (22) Total individual diversion reaches to determine total excavation.
- (23) Record the cut/fill ratio used in determining the total excavation.
- (24) Volume of earthfill in the diversion ridge in cubic yds. (Line 22, Total Excavation / Line 23, Cut/Fill Ratio)

Record the following items in the appropriate locations:

- (25) Complete the design cross section by filling in the appropriate values in the locations provided.
- (26) Signature of person doing the design and date.

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(27) Signature of person checking the design and date.

(28) Signature of person approving the design and date.

(c) Approved computer programs may be used to calculate design dimensions and volumes. Approved TI-59 calculator programs may be used to determine volumes of excavation. LOTUS template STOR2.WK1 may be used in designing diversions with underground outlets. Proper documentation for use of STOR2.WK1 is found in the underground outlet portion of PART 591 - Terrace - 600. The printer output from any program used should be attached to the field sheet.

§KS580.03 Checkout

(a) Diversions constructed with laser-equipped machinery will require the same checkout documentation as diversions constructed with other types of construction equipment.

(b) Use the backside of Form KS-ENG-8 and record the following items. Each letter represents the corresponding circled designation on the sample Form KS-ENG-8 on page KS580-7.

- (a) Under the "Channel and Ridge Profiles" section, "Diversion No." block, record the rod readings of the diversion channel and ridge at 100-foot intervals--more frequently, if necessary. Take at least one channel rod reading on the centerline of channels 15 feet wide or less. Take at least two rod readings in the channel (near the outer edges of the bottom) for widths from 15 to 30 feet. Take at least a centerline rod reading and a rod reading near each of the outer edges of channels over 30 feet wide. Record the difference of the channel rod reading from the ridge rod reading in the ("Ht.") column. Check all diversions.

Under "Cross-Section":

- (b) Show diversion number and station where the cross section was taken.
- (c) List dimensions on the lines and rod readings in the circles provided.
- (d) Take a minimum of one cross-section for each diversion reach.
- (e) Record the type of measuring device and calibration factor.

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Record the following in the table provided:

- (f) Diversion number
- (g) Counter reading and constructed length in feet.
Diversion length is to begin at that point where design height has been obtained and shall end at the point where design height no longer exists.

In the Checkout Volume Computations Table, record the following:

- (h) Beginning station
 - (i) Ending station
 - (j) Checkout length in ft., from Line g.
 - (k) Land slope in % (Same as Line 19 of Design)
 - (l) Area of Excavation in sq. ft. (Same as Line 20 of Design)
 - (m) Volume of excavation in cu. yds. (Line j, Checkout Length x Line l, Area of Excavation) /27
 - (n) Total individual diversion reaches to determine total excavation.
 - (o) Record the cut/fill ratio used in determining the total excavation. (Same as Line 23 of Design)
 - (p) Volume of earthfill in the diversion ridge in cubic yds. (Line n, Total Excavation divided by Line o, Cut/Fill Ratio)
 - (q) Signature of person doing checkout and date.
 - (r) Signature of person auditing the field sheet and date.
- (c) The formulas "Excavated Volume" and "Ridge Fill" are for information.

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SUBPART A - GRADIENT

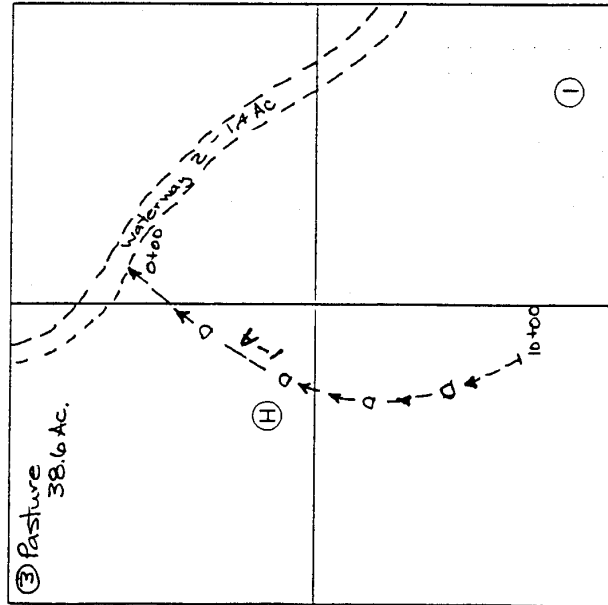
SKS580.04 Sample of Form KS-ENG-8

KS-ENG-8
Rev. 10/89

FIELD SHEET: GRADED DIVERSION - 362

USDA-SCS

Owner/Operator John R. Brown (A)
Legal Description SE 1/4 4-20S-17E (B)
County Neosho (C)
Farm No. 34(D) Tract No. 24(E) Id. No. 144(F)
Buried Utilities yes none known (G)



Scale: 1" = 330' (J)

Designed by John B. Blue (O) 3-13-90
Date
Designed by S.B. Wells (26) 3-14-90
Date
Designed by John Jones (27) 3-15-90
Date
Design Checked by John B. Blue (28) 3-16-90
Date
Design Approved by _____

Design

1. Division, No. & Reach	1-A	(1)
2. Station From To	0+00	(2)
3. Drainage area, acres	62	(3)
4. Weighted RCN	75	(4)
5. Design Q, cfs	133	(5)
6. Channel design grade, %	0.4	(6)
7. Veg. retardance or "n"	D	(7)
8. Design Slopes Cut slope	6	(8)
(X : 1)	6	(9)
Back slope	10	(10)
9. Bottom width, ft.	2.2	(11)
10. Hydr. flow depth, ft.	5.1	(12)
11. Area, sq. ft.	2.6	(13)
12. Velocity, fps	4	(14)
13. Top width of ridge, ft.	2.7	(15)
14. Design settled height, ft. (line 10 + 0.5' freeboard)	3.0	(16)
15. Min. const. height, ft. (line 14 x 1.10)		(17)

Design Volume Computations

Sta. to Sta.	Length (ft)	Land Slope (%)	Excavated Area (sq ft)	Excavated Volume (cu yds)
0+00	1,000	4	45.7	1693
(16)	(17)	(18)	(19)	(20)
				(21)

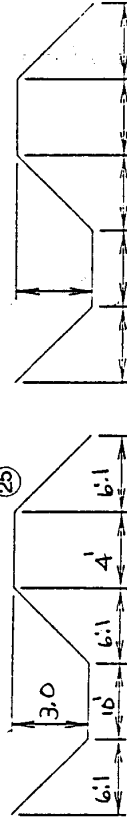
C/F Ratio 1.25(23) Total Excavation 1693 (22)
Ridge Fill ** 1354 (24)

* Excavated Volume = (Length x Area)/27

** Ridge Fill = Total Excavated Volume/ C/F Ratio

Design Cross Section

Division No. 1-A (25) Division No. _____



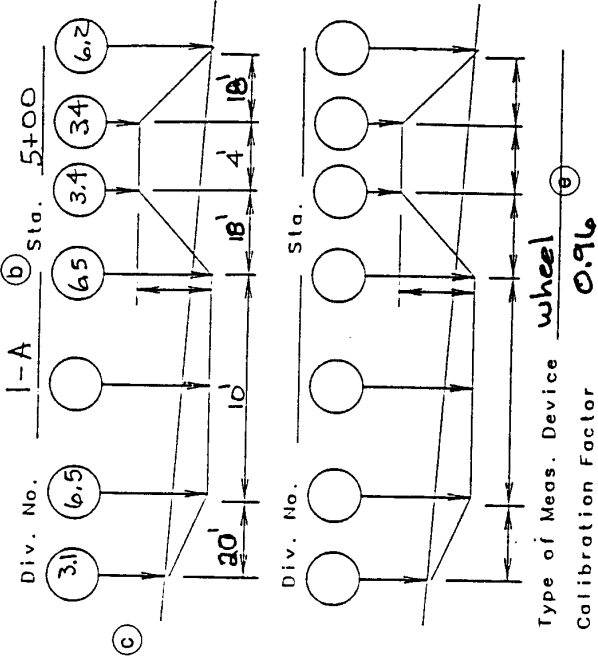
§KS580.04-2

CHECKOUT

Channel and Ridge Profiles

[illegible]

Cross Section



Div.	Counter	Length
No.	Reading	(Ft)
1-A	1050	1,008
(f)	(g)	

* Excavated Volume = $\frac{(\text{Length} \times \text{Area})}{27}$

** Ridge Fill =

Total Excavated Volume

C/F Ratio

Checkout Volume Computations

Sta.	to Sta.	Length (ft)	Land		Excavated	
			Slope (%)	Area (sq ft)	Volume * (cu yds)	
0+00	10+08	1,008	4	45.7	1,706	1,706
(11)	(1)	(1)	(k)	(1)		
C/F Ratio 1.25			Total Excavation		1,706	
			Ridge Fill		365	

Joe Dwyer 3-28-90
Joe Wells 3-30-90

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SUBPART B - LEVEL

§KS580.10 General

Design using the guidelines listed in Chapter 9 of the Engineering Field Manual and the criteria in the Kansas Standard and Specifications for Diversion - 362.

§KS580.11 Layout

Use Form KS-ENG-36 for level diversions and record the following items. Each letter represents the corresponding circled designation on the sample Form KS-ENG-36 on page KS580-13.

- (A) Owner/Operator
- (B) Legal description
- (C) County
- (D) Farm number (optional)
- (E) Tract number
- (F) Applicable identification number - GPCP, ACP, etc.
- (G) Check the appropriate line as to the known existence of any buried utilities. If buried utilities are known to exist, safety procedures listed in National Engineering Manual, Part 503, should be strictly followed.

Show the following on the location map:

- (H) Diversion location
- (I) Location of any known buried utilities
- (J) Map scale

Under the design block, list the following:

- (K) Determine diversion storage length in feet. Record this length under Line 2 of Design.
- (L) Determine the block lengths in feet. Record this length under Line 21 of Design.
- (M) Determine the land slope in percent above each reach of the diversion. Record this slope under Line 10 of Design.

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Record the following item in the appropriate location:

(N) Signature of person doing the layout and date.

§KS580.12 Design

(a) Design of level diversions may be done by the UNIX level diversion computer program, TI-59 calculator, or by manual procedures. Computer printout from the level diversion computer program will suffice for design documentation and should be attached to Form KS-ENG-36. If design is done manually, use Form KS-ENG-36 and record the following:

(b) In the design block, determine and list the following items. Each number represents the corresponding circled designation on the sample Form KS-ENG-36 on page KS580-13.

- (1) Diversion, Number, and Reach
- (2) Diversion storage length in feet, already completed by Line K of Layout.
- (3) Drainage area in acres
- (4) Weighted runoff curve number
- (5) Rainfall - frequency in years and amount in inches
- (6) Runoff in inches
- (7) Anticipated 10-year sediment in inches
- (8) Total of runoff and sediment in inches
- (9) Storage needed in cubic feet per foot of diversion
(Line 3, Drainage Area in Acres x Line 8, Runoff and Sediment in inches x 3630 / Line 2, Diversion Storage Length in feet)
- (10) Land slope at diversion in percent, already completed by Line M of Layout.
- (11) Design slopes - cut slope:1, front slope:1, back slope:1
- (12) Channel bottom width in feet
- (13) Constructed height in feet - from design curves or tables in the Kansas supplement to Chapter 9 of the Engineering Field Manual

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- (14) Diversion fill area in cubic feet per foot - from design curves or tables in the Kansas supplement to Chapter 9 of the Engineering Field Manual
- (15) End block height in feet - from design curves or tables in the Kansas supplement to Chapter 9 of the Engineering Field Manual
- (16) Cut depth in feet - from design curves or tables in the Kansas supplement to Chapter 9 of the Engineering Field Manual
- (17) Storage depth in feet (Line 16, Cut Depth + Line 15, End Block Height)
- (18) Top width of fill in feet

Under the volume computations on the front of Form KS-ENG-36, list the following:

- (19) Diversion and block numbers
- (20) Length of line in feet - from Line 2
- (21) Length of blocks in feet, already completed from Line L of Layout.
- (22) Line area of fill in cubic feet per foot - from Line 14
- (23) Block area of fill in cubic feet per foot - average of line area of fill and end area of fill of block, where end area of fill of block is represented by:

$$(A * \text{side slopes} + \text{top width}) * A$$

where A = constructed height - storage depth

It is recommended that this calculation be shown on the field sheet or attached on a separate sheet of paper.

- (24) Volume of fill in line and blocks in cubic yards. Also, total the individual computations of length x area / 27.
- (25) Record the cut/fill ratio used in determining the estimated fill volume.
- (26) The typical cross section is shown for information purposes only. Design dimensions may be added if desired.

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Record the following items in the appropriate locations:

- (27) Signature of person doing the design and date.
- (28) Signature of person checking the design and date.
- (29) Signature of person approving the design and date.

§KS580.13 Checkout

(a) Use the backside of Form KS-ENG-36 and record the following items. Each letter represents the corresponding circled designation on the sample Form KS-ENG-36 on page KS580-14.

Show the following under the "Channel and Ridge Profiles" section:

- (a) Record the Diversion No. and the rod readings of the diversion channel and ridge at 100-foot intervals--more frequently, if necessary. Take at least one channel rod reading on the centerline of channels 15 feet wide or less. Take at least two rod readings in the channel (near the outer edges of the bottom) for widths from 15 to 30 feet. Take at least a centerline rod reading and a rod reading near each of the outer edges of channels over 30 feet wide. Check all diversions.
- (b) Record the average channel rod in the proper block below the Channel and Ridge Profiles Table. The average channel rod is determined by taking the average of all of the channel rod readings.
- (c) Record the difference of the average channel rod from the ridge rod in the ("Ht.") column. Check all diversions.
- (d) Record the minimum allowable ridge rod in the proper block below the Channel and Ridge Profiles Table. The minimum allowable ridge rod is the difference between the average channel rod and the design constructed height.
- (e) Record the block grade rod in the proper block below the Channel and Ridge Profiles Table. The block grade rod is the difference between the average channel rod and the design storage depth.

(b) Diversions constructed with laser-equipped machinery will require the same checkout documentation as diversions constructed with other types of construction equipment.

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Show the following under "Cross-Section":

- (f) Diversion number and station where the cross section was taken.
- (g) List dimensions on the lines and rod readings in the circles provided.
- (h) Make a minimum of one cross section for each diversion.
- (i) Type of measuring device and calibration factor.

Record the following in the Checkout Volume Computations Table:

- (j) Diversion and block number - Leave block numbers blank if they are not needed to record lengths of vertical blocks for volume calculations.
- (k) Counter reading and constructed length in feet for diversions and blocks
- (l) Fill area for the diversion as taken from Line 14 of Design
- (m) Fill areas for blocks as taken from Line 23 of Design
- (n) Volume of fill in the line, cubic yards (Line k, Constructed Line Length x Line l, Area of Fill) / 27
- (o) Volume of fill in blocks, cubic yards, (Line k, Constructed Block Length x Line m, Average Fill Area) / 27
- (p) Total volume of fill, cubic yards, by adding the cubic yards of fill in diversion lines and all blocks.

Show the following in the appropriate locations:

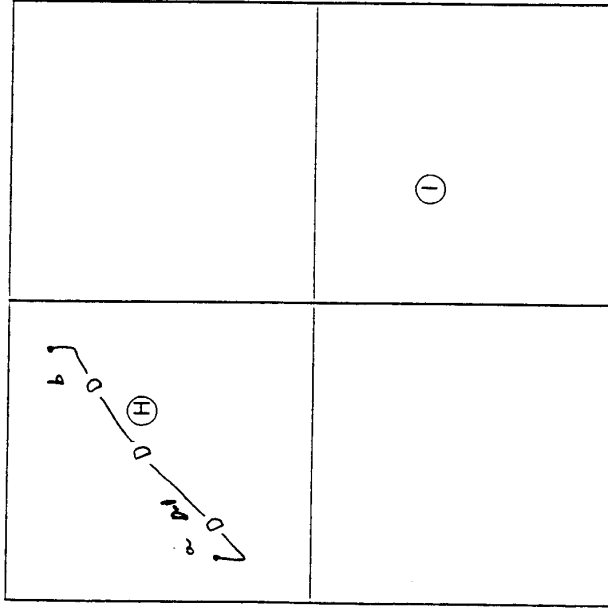
- (q) Signature of person doing checkout and date.
 - (r) Signature of person auditing the field sheet and date.
- (c) The formula "Volume" is for information.

SUBPART B - LEVEL

BKS580.14 Sample of Form KS-ENG-36

KS-ENG-36

Rev. 10/89

FIELD SHEET: Level Diversion
Design and LayoutOwner/Operator John R. Brown (A)Legal Description NW 1/4 35-23-31 (B)County Garfield (C)Farm No. 144 (D) Tract No. 26 (E) Id. No. 3 (F)Buried Utilities yes none known (G)Scale: 4" = 1 mile (J)Design by J. Blue (N)Layout by B. Wells (27)Date 10-31-89Design by J. Blue (28)Date 10-31-89Design Checked by B. Wells (29)Date 10-31-89Design Approved by Date

Design

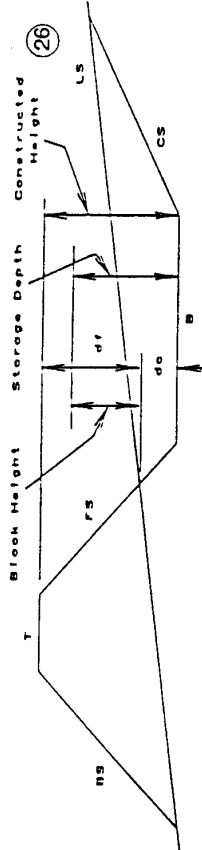
Diversion, no.	1
Length, feet	2600 (K2)
Drainage area, DA, acres	100 (3)
Weighted runoff curve number	77 (4)
Rainfall (10 yr, 24 hr), in.	4.0 (5)
Runoff, R, inches	1.8 (6)
Sediment, S, inches	0.2 (7)
Runoff + Sediment, inches	2.0 (8)
Storage needed, cu. ft./ft.	279,200 (9)
Land slope at basin, LS, %	1.0 (M10)
Design slopes Cut slope, CS	1.0
(X:1) Front slope, FS	8 (11)
Back slope, BS	8 (12)
Channel width, B, feet	100 (13)
Constructed height, feet	3.0 (14)
Diversion fill area, cu. ft./ft.	76,560 (15)
End block height, dh, feet	1.9 (16)
Cut depth, dc, feet	0.4 (17)
Storage depth, ds = dc + dh, ft.	2.3 (18)
Top Width, T, feet	4 (19)

Storage Needed =
DA x (R+S) x 3630
Length

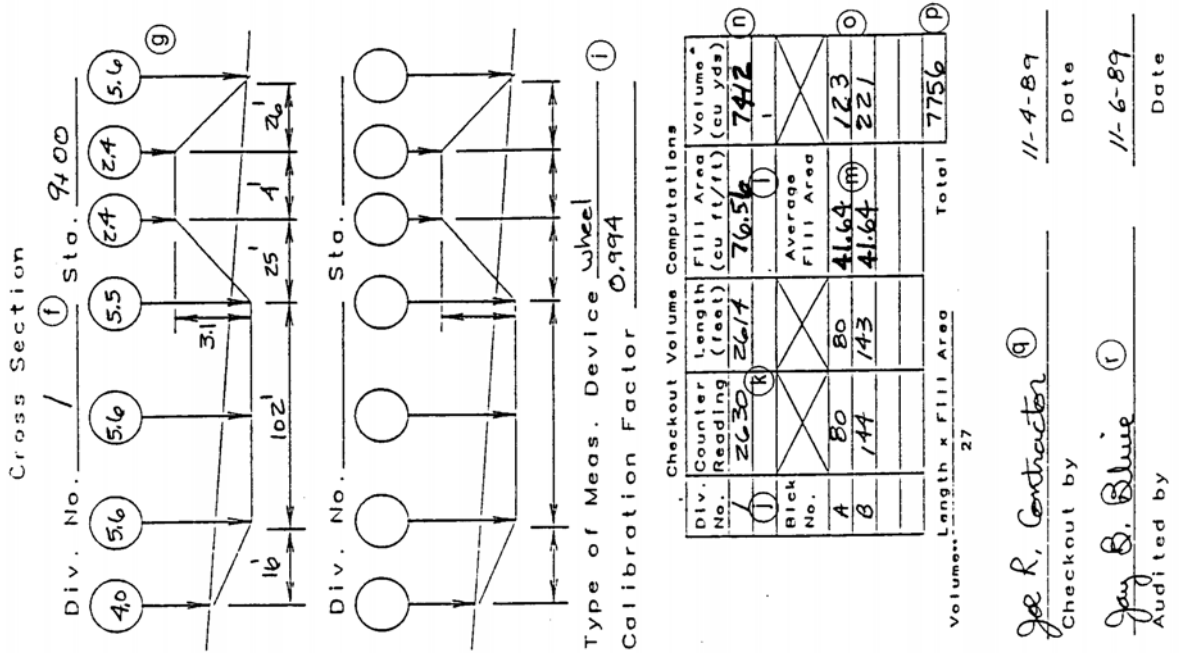
Volume of Fill =
Length x Area

Estimated Volume Computations

Diversion No.	Length (Feet)	Area of Fill (cu. ft./ft.)	Volume of Fill (cu. yds.)
Line 19	2600 (20)	76,560 (22)	7372 (24)
Block	300 (21)	41,664 (23)	463
Line			
Block			
C/F Ratio =	1.35 (25)	Estimated Fill	7835
Block Area			
A = 3.0 - 2.3			
A = 0.7			
(0.7 x 8 + 4) x 0.7			
= 6.72			
6.72 x 76,560			
= 41,664			



KS580-14.2



CHECKOUT

Channel and Ridge Profiles

Sta.	Diversion No. /		Sta.	Diversion No. /		Sta.	Hit. (ft)	Channel Rod	Ridge Rod	Hit. (ft)
	Channel Rod	Ridge Rod		Channel Rod	Ridge Rod					
Block	5.5	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
0+00	5.5	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
1	5.5	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
2	5.4	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
3	5.3	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
4	5.4	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
5	5.3	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
6	5.3	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
7	5.4	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
8	5.5	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
9	5.6	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
10	5.4	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
11	5.3	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
12	5.5	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
13	5.5	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
14	5.4	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
15	5.5	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
16	5.4	5.3	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
17	5.4	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
18	5.5	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
19	5.6	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
20	5.7	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
21	5.7	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
22	5.6	5.5	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
23	5.5	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
24	5.6	5.5	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
25	5.7	5.5	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
26	5.6	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
Block	5.5	5.4	3.2	5.5	5.4	3.2	3.2	5.5	5.4	3.2
Avg. Channel Rod										
Min. All. Ridge Rod										
Block Grade Rod**										

*Hit. = Avg. Channel Rod - Ridge Rod

**Block Grade Rod = Average Channel Rod - Storage Depth

KS580-14

